

## CHAPTER 8 - PLASTIC AND ELASTOMERIC STRUCTURES

### SECTION 1. TYPES OF MATERIALS

Several plastic and elastomeric materials are finding practical use as substitutes for wood, concrete, or steel in waterfront structures or as components in these structures. Mention was made of them in the chapters on wood, concrete, and steel, but they are described in this chapter in more detail.

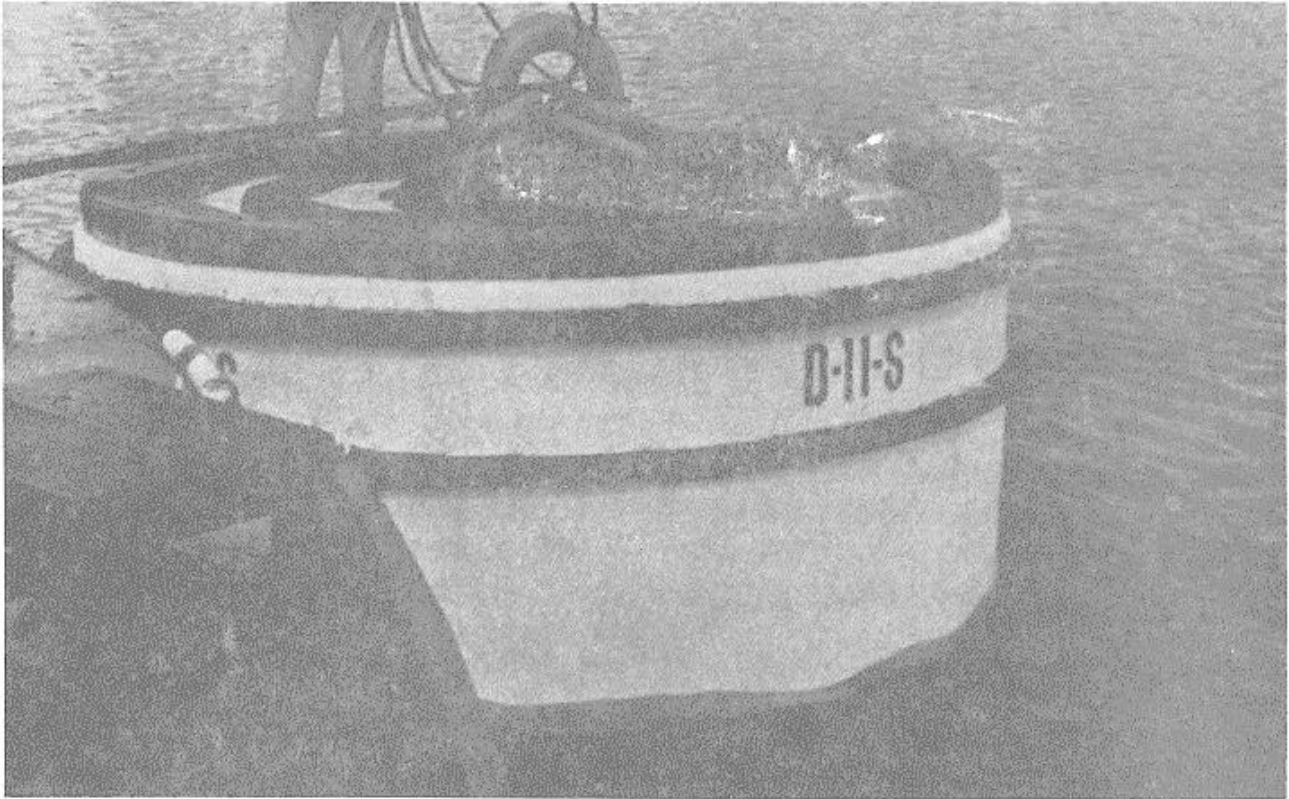
**8.1.1 FIBERGLASS-REINFORCED PLASTICS.** The reinforcement of plastics (usually polyester or epoxy) with glass fibers yields a product with improved physical properties [8-1] while retaining its light weight. The plastics are generally quite resistant to deterioration in a marine environment as long as no uncoated glass fibers are allowed to come into contact with water. Materials of such construction have been used in buoys (Figure 8-1), floats, and brows.

**8.1.2 FOAMS.** Foamed plastics, which are available with a variety of chemical compositions and physical properties (e.g., density, strength, water permeability, etc), are used to impart buoyancy to waterfront structures. They can be formulated to be fire-resistant, and they can be coated for additional resistance to water penetration and to deterioration by weathering. Urethane foams are the most useful to public works personnel because they can be foamed-in-place relatively easily [8-2]. Most tend to yellow and slowly degrade, however, when exposed to direct sunlight;

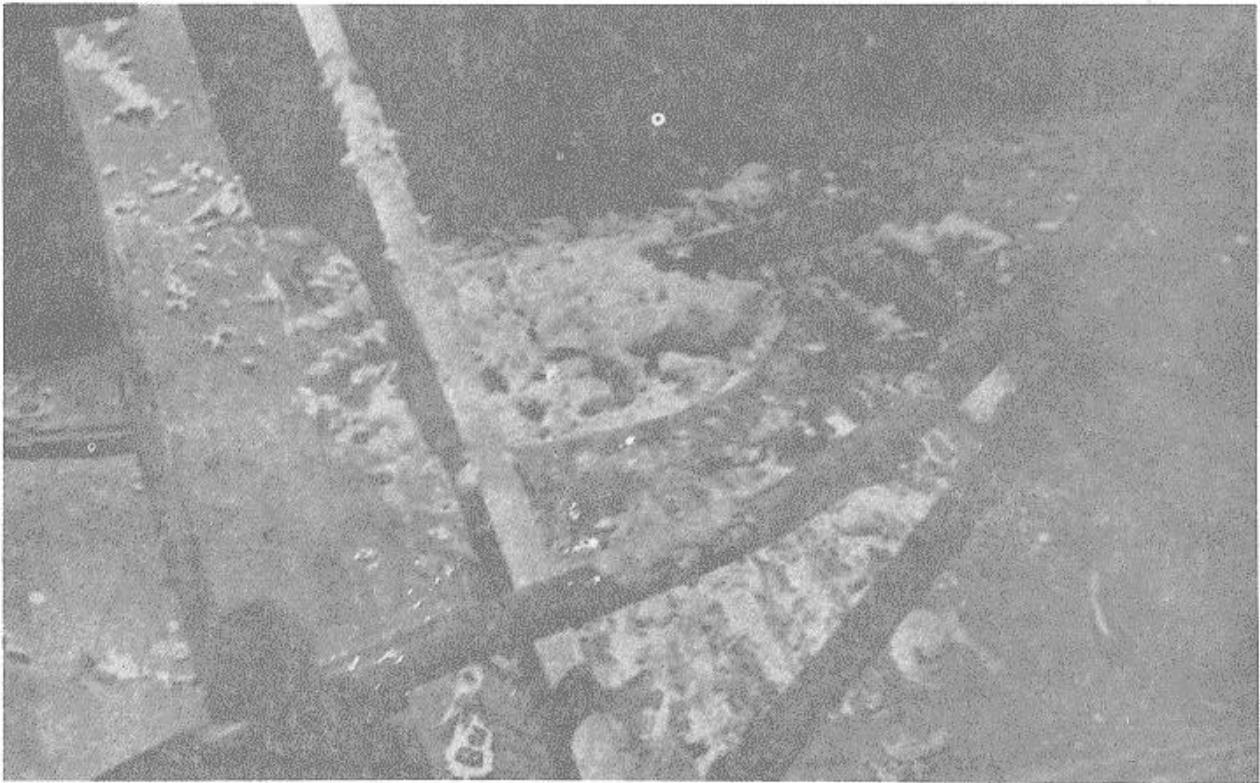
thus, they are used to fill enclosed, hollow cavities (Figure 8-2). Polystyrene foam (Styrofoam®) is relatively inexpensive to purchase in quantity and can be cut to desired shapes. This material, covered by an inverted box deck, is used extensively for small boat moorings in marinas. Syntactic foams are produced by bonding hollow glass or plastic balloons together with an epoxy resin to produce a strong foam that is resistant to water penetration. This type of foam is used for buoyancy in deep-submergence operations.

**8.1.3 RUBBERS.** A number of natural and synthetic rubbers are molded into a variety of products, such as fenders, that vary in size, shape, and physical properties. These products are easily secured in place with cables or a line of bolted plates in hollow structures or with an adhesive. They find use on piers, wharves, landing floats, camels, mooring buoys, and pilings (Figure 8-3).

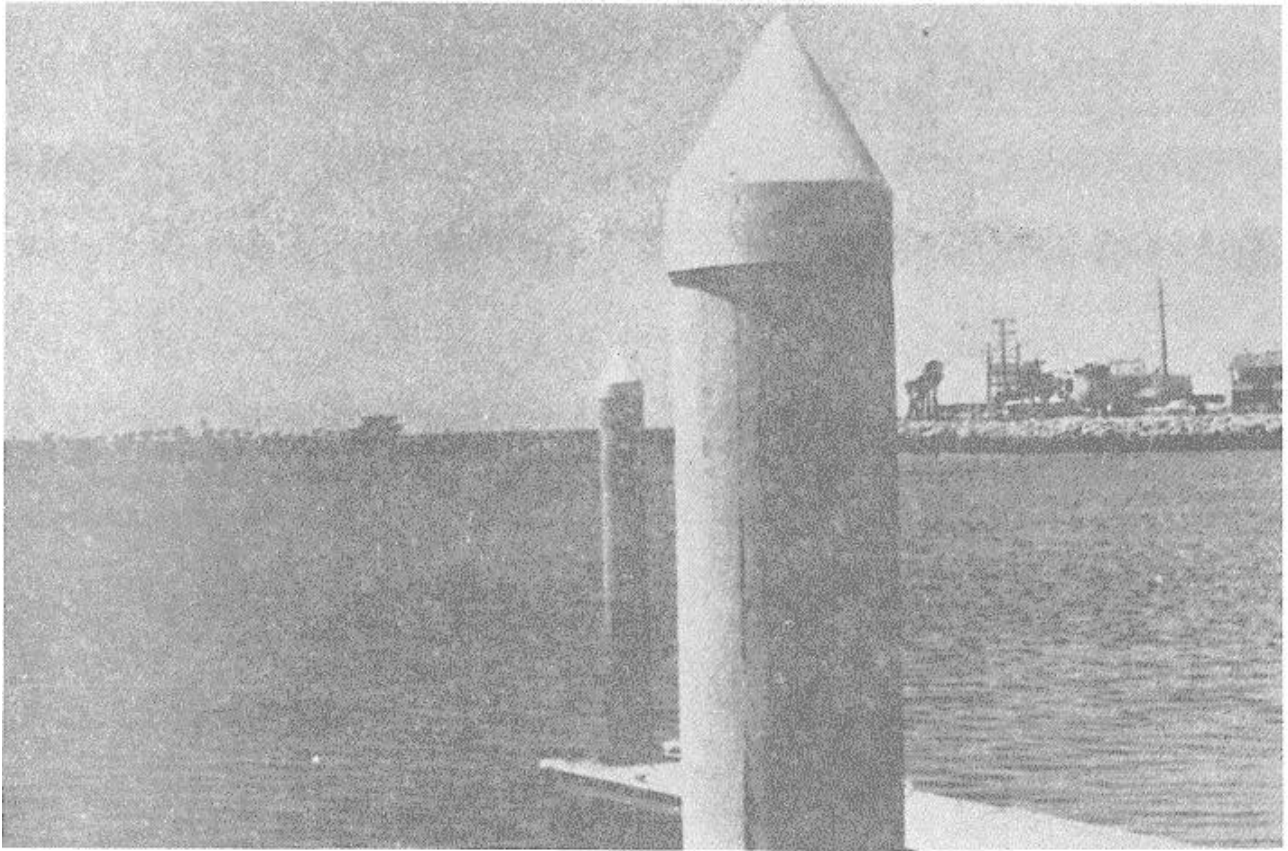
**8.1.4 PLASTIC WRAPS.** Wraps of flexible PVC have been used to produce an oxygen deficient environment around wood piling to prevent the growth of wood boring organisms (Figure 8-4), and around steel piling to control corrosion. References 8-3 and 8-4 describe how to install this type of system on wooden piling, and Reference 7-9 describes its use on steel piling.



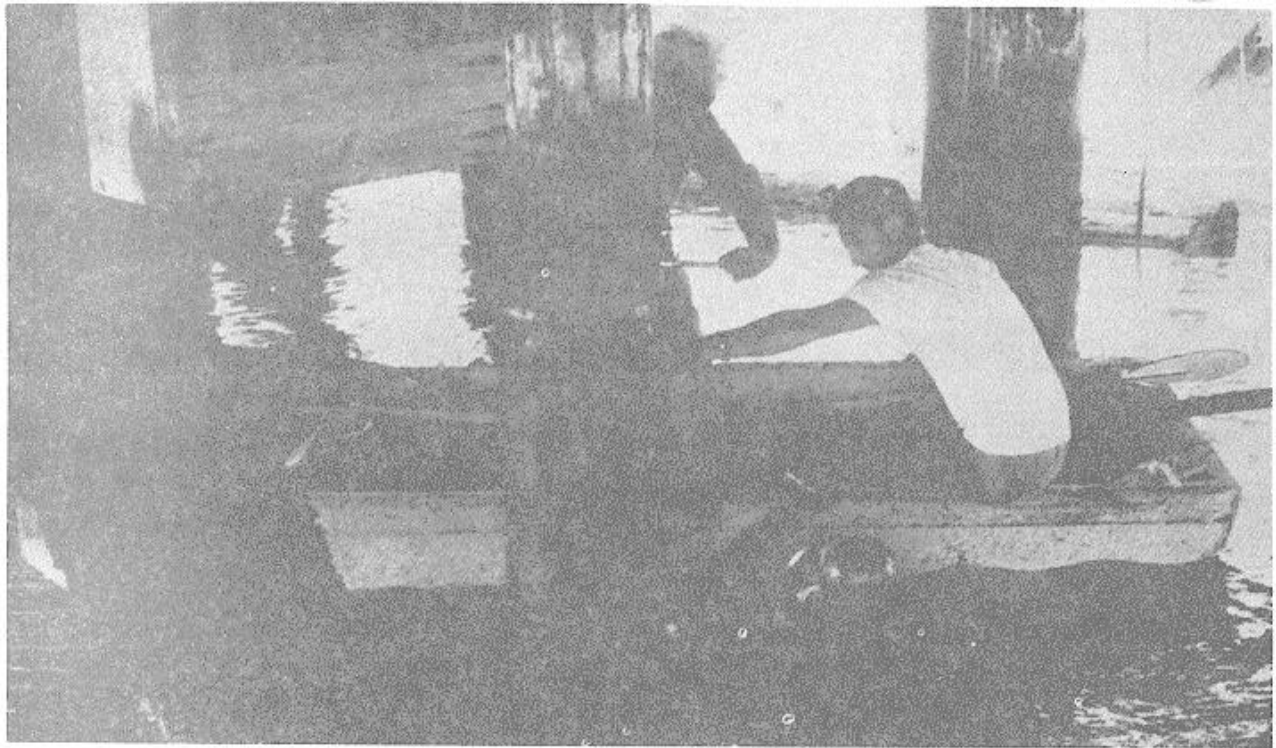
*Figure 8-1. Fiberglass-reinforced plastic mooring buoy.*



*Figure 8-2. Pontoon filled with urethane foam to impart buoyancy.*



*Figure 8-3. Synthetic rubber molded into pile cap. Shape keeps birds from landing and snow from collecting.*



*Figure 8-4. PVC barrier being installed around marine-borer-damaged pile.*

**8.1.5 ADHESIVES AND PUTTIES.** Several chemically curing epoxy formulations have been developed that will bond to damp and underwater surfaces. They can be used to bond structures or their components; to pot connections, joints, or other metal configurations

susceptible to corrosion; or to patch holes above or underwater. Reference 8-5 describes one such formulation that was developed by the Civil Engineering Laboratory.

## **SECTION 2. CONSTRUCTION TECHNIQUES**

**8.2.1 LAY-UP CONSTRUCTION.** In lay-up construction, alternate layers of fiberglass cloth (woven roving) or alternate layers of fiberglass cloth and mat impregnated with catalyzed resin are placed over each other on a mold or other surface to build a laminate of desired strength. The first coat (gel coat) and last coat of resin (usually polyester or epoxy) completely encapsulate the fiberglass.

**8.2.2 SPRAY-UP CONSTRUCTION.** In spray-up construction a special spray gun is used that chops glass fibers and extrudes them into a spray of catalyzed resin (usually polyester or epoxy). The irregular film that is formed on the mold or surface is then leveled with a disc roller. This technique can be repeated to build up any desired thickness of fiberglass-reinforced plastic.

**8.2.3 FILAMENT WINDING.** Filament winding is a highly specialized technique usually accomplished at a factory. A structure, such as a buoy or pipe, is fabricated by winding a continuous glass filament wetted with resin (either polyester or epoxy) around a mandrel at the desired winding angle. Any desired thickness of fiberglass-reinforced plastic can be produced in this

manner. The process is relatively expensive but produces a very strong and corrosion-free structure.

**8.2.4 FOAMING IN-PLACE.** Urethane foams can be poured in-place using pails of catalyzed resin or sophisticated metering and dispensing equipment. The rate of rise, density, flammability, and resistance to water penetration can be varied by using different compositions.

**8.2.5 PIER WRAPPING.** The system described in Chapter 2 for wrapping wooden piling with sheets of PVC can be used for wrapping steel piling [7-10] .

**8.2.6 PATCHING IN-PLACE.** Holes, cuts, or dents in metal structures can be patched with epoxy adhesives or putties. Formulations are available for dry and wet surfaces, low and high temperatures, and fast and slow curing. The steel must be cleaned by abrasive blasting or wire brushing before the catalyzed epoxy is placed on it. Leaks in floating structures can be repaired only after the flow of water has been terminated.